Plants and photosynthetic algae play a fundamental and beneficial role in our life because they create oxygen, energy, food, and many useful products such as drugs, materials, and fibers. These organisms can be extraordinarily different in their shape and size. Nevertheless, they are all united by the presence of specialized cell compartments, the chloroplasts. In these membrane-bound-organelles, complex molecular machines carry out a multitude of essential biochemical reactions, including photosynthesis – the remarkable process by which sunlight energy is harnessed to convert atmospheric carbon dioxide and water into sugars and oxygen. These machines are often composed of proteins that are encoded in two physically separated intracellular compartments (the nucleus and the chloroplasts themselves), must assume a specific structure (fold) to be functional and must be quickly refolded or degraded when damaged.

Research over the last few decades has shown that chloroplast damage has drastic consequences for plant growth and performance. Yet, we know very little about the quality control checkpoints and strategies that a photosynthetic cell exerts to preserve chloroplast integrity or to recycle misassembled or worn-out chloroplast molecular machines in response to internal and external stresses. Thus, to enable rational engineering of photosynthetic organisms more resilient to stress, a mission for the greater good of our growing world population, it is important to first advance our understanding of the signaling pathways that monitor and maintain the health of chloroplasts.

By joining my lab, you will become part of a multi-skilled and diverse research team that will employ cutting-edge technologies to gain an in-depth genetic, molecular and biochemical understanding of the ‘chloroplast unfolded protein response’ (or cpUPR for short), an evolutionarily conserved, key signaling pathway that allows photosynthetic eukaryotes to sense the presence of damaged proteins in the chloroplast and to mitigate the resulting stress by reprogramming nuclear gene expression.

To unravel how the presence of unfolded proteins inside the chloroplast is sensed, how the signals are transduced across compartmental boundaries, and to what extent the genes activated during this response help plant cells to adapt to stress, you will have the possibility to choose amongst three different but synergistic research objectives: the structural and functional dissection of the Mars1 kinase (this being the only currently known cpUPR signaling player), the identification and characterization of other cpUPR signaling components, and the systematic investigation of yet-uncharacterized genes activated during the cpUPR.

Furthermore, you will have the opportunity to become familiar with two different but highly complementary model systems for these studies: *Chlamydomonas reinhardtii*, a single-celled and facultative photosynthetic eukaryote where we can combine biochemical and genetic approaches with the innovative power of high-throughput robotics, and *Arabidopsis thaliana*, a multicellular photosynthetic eukaryote where we can explore how intracellular signaling pathways have been shaped during evolution to meet the specific developmental needs of land plants.